



466729



Engineers
Planners
Economists
Scientists

FEB 04 91

1020/1021
3501/1021

Mark Schmitt
Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, Minnesota 55155

Dear Mark,

During our phone conversation last month, you consented to review the draft case study of the General Mills site in Minneapolis. I have enclosed a copy for your review and look forward to receiving your comments. Thank you for your continued participation in this effort.

Sincerely,

Christine L. Roberts
Environmental Planner

GENERAL MILLS SITE, CASE STUDY UPDATE

BACKGROUND OF THE PROBLEM

The original case study for the General Mills site (EPA 1989, Case Study 7) presented background information and data from ground-water monitoring and extraction systems up through 1988. The General Mills site is located approximately one mile northeast of the Mississippi River on Hennepin Avenue on the outskirts of downtown Minneapolis. Figure 1 shows the site contamination location. Site contamination is a result of disposal of chemical solvents in a soil adsorption pit located in the southeast corner of the General Mills property. The source of contamination is chemical research that occurred at General Mills between 1947 and 1962. In 1981, the MNPCA was apprised of site contamination.

General Mills and MNPCA are jointly pursuing site cleanup under a 1984 Response Order by Consent. Operation of a ground-water extraction and treatment system began in 1985 and has functioned continuously since then, exclusive of routine maintenance and repair.

Four aquifers underlying the General Mills property are pertinent to aquifer remediation efforts at the site--the shallow aquifer, the Carimona and Magnolia Members of the Platteville Formation, and the St. Peter Sandstone.

The shallow unconsolidated aquifer (also known as the glacial drift aquifer) is unconfined and flows southwest toward the Mississippi River. A layer of glacial till and the Decorah Shale, when present, separate the glacial drift aquifer from the underlying bedrock aquifer. The layers impede, but do not prevent downward flow of ground water to lower aquifers.



Figure 1
SITE LOCATION MAP
GENERAL MILLS SITE, MINNEAPOLIS, MN

The Carimona Member of the Platteville Formation underlies the glacial aquifer and consists of three to four feet of fractured and weathered micrite, a fine-grained limestone. The piezometric surface in the Carimona is relatively flat. The Carimona Member is separated from the underlying Magnolia Member by a thin bentonite layer that impedes downward flow. The head in this aquifer is on average four to five feet higher than the underlying Magnolia Member, thus indicating the potential for downward flow.

The Magnolia Member of the Platteville Formation is approximately eight feet thick with a northwesterly flow. Below this aquifer is a 22 to 27 foot thickness of alternating layers of shale, limestone, and dolomite that impede the downward flow of water. The head difference between this aquifer and the underlying St. Peter Sandstone is 55 feet with a downward flow.

The primary contaminants at the site are chlorinated organic solvents, including trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1,1-trichloroethane (TCA), and the degradation products of these compounds. The most prevalent compound detected was TCE.

Groundwater contamination is highest in the glacial drift and Carimona aquifers with respective maximum TCE concentrations of 1,300 ppb and 2,300 ppb. Lesser TCE concentrations were found in the Magnolia Member (440 ppb) and in the St. Peter Sandstone (<100 ppb).

UPDATE ON SITE CHARACTERISTICS

The updated case study is based on 1989 data obtained from the MNPCA consisting of extraction well pump-out rates, contaminant concentrations, and technical specifications for an additional pump-out system. File correspondence between MNPCA and General Mills, and personal communications with MNPCA personnel supplemented the

technical reports. The MNPCA continues to oversee remediation activities at the General Mills site.

Ground water elevations were measured during April, July, and October 1989 for the following aquifers: Shallow Glacial Drift Aquifer, Carimona and Magnolia Members, St. Peter Sandstone, and the Prairie du Chien and Jordan formations. Water levels for the upper three aquifers are displayed graphically in Figures 2, 3, and 4.

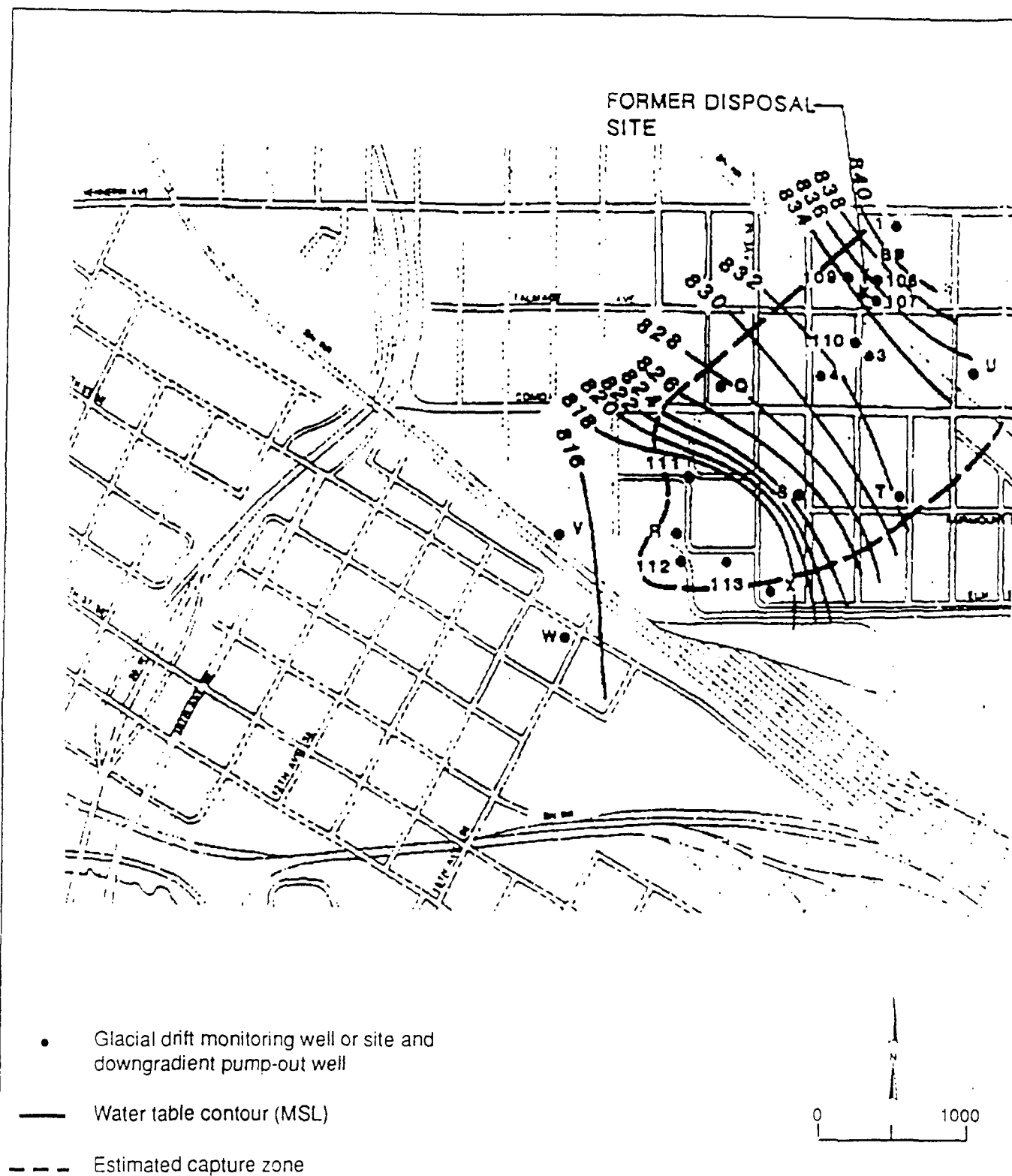
Ground-water levels in the upper three aquifers remain consistent with those levels found in the original case study. The surface elevation monitoring data collected during 1989 also suggest hydraulic gradients similar to those identified in 1988. No results for the lower two aquifers are provided in the 1989 Annual Report.

WASTE CHARACTERISTICS

During 1989, ground water at the General Mills site was tested to determine the concentration levels of both chlorinated and non-chlorinated volatile solvents. As identified in the original case study, TCE remains the most prevalent compound in the groundwater.

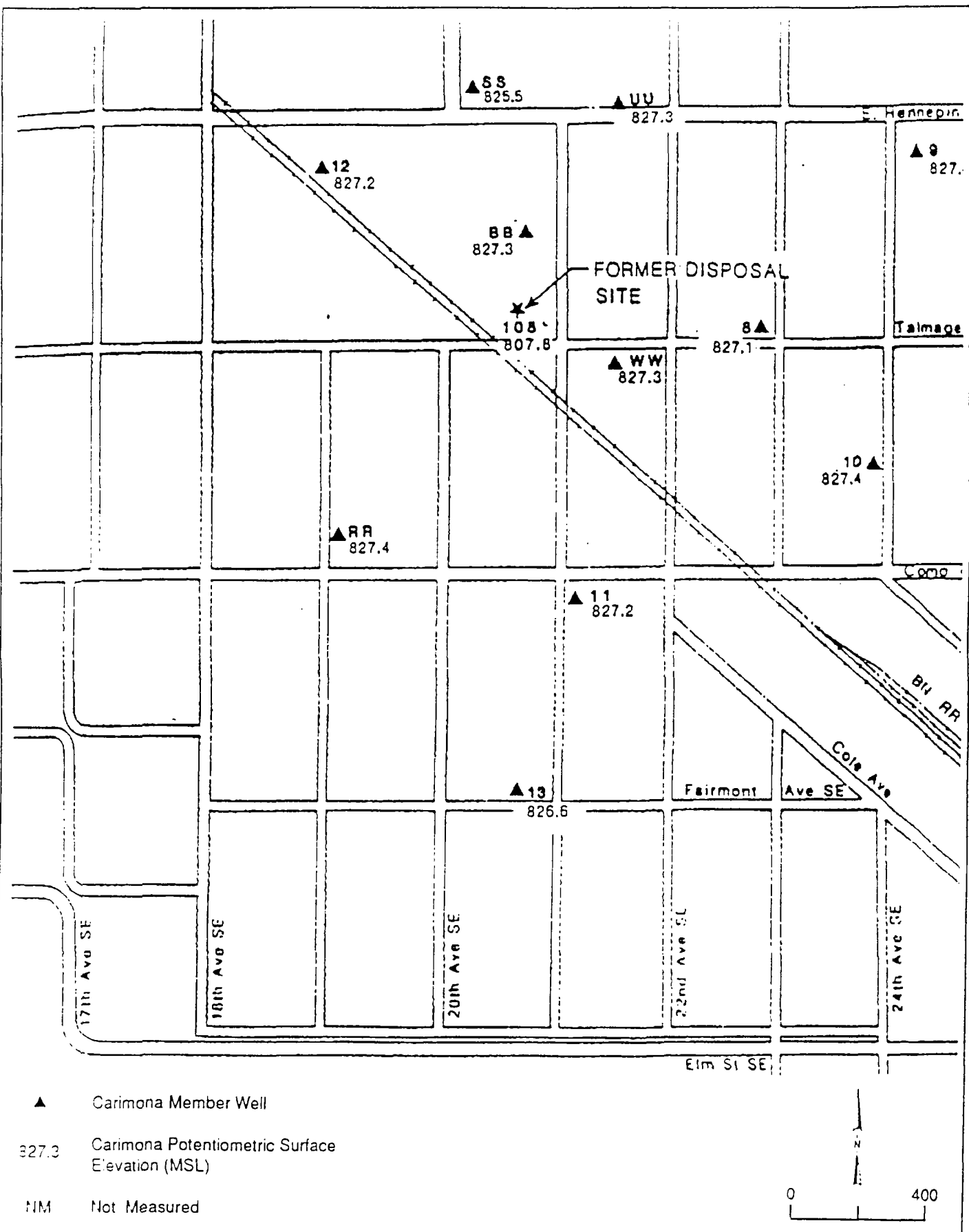
In addition to TCE levels in the shallow aquifer and the Carimona Member in excess of the MNPCA's standards, above-threshold levels were detected in the Magnolia Member in 1989. According to the original consent agreement, General Mills was required to install an extraction system in the Magnolia when TCE levels surpassed 27 ppb.

The detection of TCE above 27 ppb in upgradient Magnolia wells indicates that General Mills site is not the only source of contamination in the Magnolia Member. Although the MNPCA determined the proposed Magnolia system would treat contaminated water in the Magnolia aquifer, the agency concluded that proceeding with the Magnolia extraction system would capture only a small portion of the Magnolia



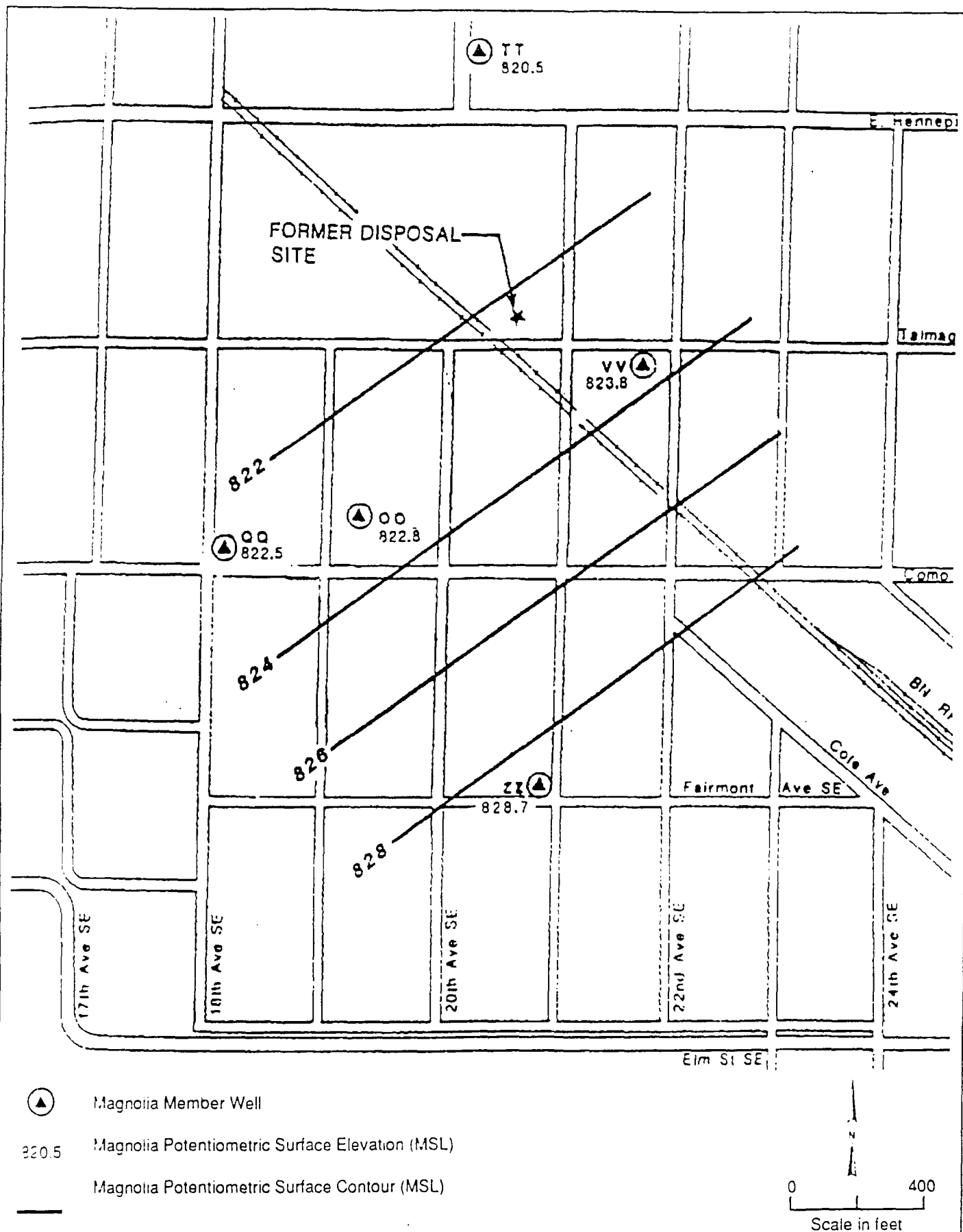
Source: BARR 1989

Figure 2
WELL LOCATIONS AND WATER LEVELS
IN THE SHALLOW AQUIFER, APRIL 1989
GENERAL MILLS SITE, MINNEAPOLIS, MN



Source: BARR 1989

Figure 3
WELL LOCATIONS AND WATER LEVELS IN THE
CARIMONA MEMBER, APRIL 1989
GENERAL MILLS SITE, MINNEAPOLIS, MN



Source: BARR 1989

Figure 4
WELL LOCATIONS AND WATER LEVELS IN THE
MAGNOLIA MEMBER, APRIL 1989
GENERAL MILLS SITE, MINNEAPOLIS, MN

plume. The MNPCA eventually decided in October 1989 to proceed with system expansion but the source of contamination in the Magnolia Member remains unknown.

REMEDIATION

DESIGN AND OPERATIONAL FEATURES OF REMEDIATION SYSTEM

The goal of remediation efforts established at the time of the initial case study is twofold. The aim is first to minimize further migration of volatile organic hydrocarbons, particularly TCE. The second goal is to contain and reduce TCE concentrations in the shallow aquifer to less than 270 ppb and in the underlying aquifers to less than 27 ppb.

To effect these goals, the remediation method chosen at the General Mills site consists of onsite and down-gradient extraction systems that began operation in November 1985. The onsite system includes three extraction wells--two in the shallow aquifer (Wells 109 and 110) and one in the Carimona Member (Well 108). Since operation began in 1985, the combined average withdrawal rate for 109 and 110 has been 70 gpm, and the extraction rate for the Carimona well has varied between 20 and 30 gpm. Three additional extraction wells are located downgradient from the contamination site in the shallow aquifer system (Wells 111, 112, 113) and the combined extraction rate has been about 300 gpm.

According to the water-level data presented in the original case study, pumping rates of about 50 gpm at each of the shallow-aquifer system wells (109, 110, 111, 112, 113) would result in a capture zone extending 100 feet on either side of the well. The earlier case-study installment identified a clear capture zone in the three shallow-aquifer downgradient wells, but the two source-area wells did not exhibit clear containment areas. Data obtained from 1988 pumping tests in the Carimona indicate

that a similar 50 gpm rate in the Carimona Member would isolate a capture zone extending beyond the monitoring wells.

Minor modifications during 1989 to the shallow aquifer and Carimona extraction systems consist of reduced extraction rates caused by pump malfunctions. The extraction wells for these systems operated continuously between 1985 and 1988 except for general maintenance downtime. In the one-year interim between publication of the original case study and this update, the extraction-well systems continue to operate; however, electrical and mechanical problems with system pumps resulted in downtime and reduced extraction rates for both the shallow aquifer and Carimona Member.

In the shallow aquifer, the 1989 combined average monthly withdrawal rate of source-area Wells 109 and 110 was 75 gpm (Barr 1989, Annual Report). Although the wells were operated at maximum sustainable yield during 1989, extraction rates decreased to 51 gpm during the last three months of 1989 due to pump failures in both wells.

The average extraction rate in 1989 for the downgradient shallow-aquifer wells (111, 112, 113) was 290 gpm, with the average monthly rates for individual wells ranging from 90 to 107 gpm. The shallow aquifer downgradient system removed 150 million gallons of groundwater in 1989. A total volume of 42 million gallons of ground water was removed from the shallow aquifer in 1989 (Barr 1989, Annual Report). Table 1 displays the average monthly pumping rates and downtime at individual wells.

In the Carimona Member, Well 108 continues to withdraw water as part of site remedial actions. Its purpose is to contain and remediate water in the Carimona Member where concentrations of TCE exceed 27 ppb. The average rate for Well 108 in the Carimona system was 16 gpm in 1989. A total volume of 8.7 million gallons of ground water was removed from the Carimona and Magnolia Members in 1989. This rate is reduced from 1988 yields due to pump failure in Well 108, resulting in 46 days of downtime in the last three months of 1989.

	1989 PUMPING RATE					
	GLACIAL DRIFT PUMP-OUT WELL					CARIMONA PUMP-OUT WELL
	Pumping Rate					Pumping Rate
	(Ave. GPM)					(Ave. GPM)
	<u>109</u>	<u>110</u>	<u>111</u>	<u>112</u>	<u>113</u>	<u>108</u>
Jan 1989	41	29	91	101	92	22
Feb 1989	51	50	91	104	92	20
Mar 1989	47	55	91	105	92	20
Apr 1989	57	44	91	106 ¹	91	20
May 1989	50	50	91	106 ¹	92	21
Jun 1989	49	50	90	104	92	20
Jul 1989	48	50	90	105	92	19
Aug 1989	20 ²	51	90	107	92	18
Sep 1989	8.2 ²	51	90	104	92	19
Oct 1989	0.0 ²	44 ²	90	104	93	1.8 ²
Nov 1989	16 ²	25 ²	90	106	93	5.6 ²
Dec 1989	45 ²	23 ²	90	106	93	12 ²

¹ Flow meter malfunction.

² Wells not pumping full-time due to faulty motor control.

Source: BARR 1989

Table 1
1989 PUMPING RATES
GENERAL MILLS SITE MINNEAPOLIS, MN.

The major modification to the extraction system in 1989 was the decision to expand the extraction system into the Magnolia Member of the Platteville Formation. This decision was postponed, however, so that the MNPCA could review remedial-action alternatives other than ground-water extraction (MNPCA Correspondence to General Mills 1990). In the first three quarters of 1989, MNPCA personnel explored the possibility of soil removal but determined that contamination had migrated from the soil profile into the ground water. In October 1990, the MNPCA approved implementation of the proposed Magnolia system as the remedial alternative which represented optimal use of remedial action funds (MNPCA, Memorandum to General Mills 1990).

After the MNPCA selected ground-water extraction as the most feasible remedial alternative, General Mills submitted a work plan detailing the methodology used to collect the hydrologic data. The major analytical considerations in designing the Magnolia extraction system include aquifer tests and capture-zone design, both of which are still in the planning stage.

Two aquifer tests, conducted in both the Carimona and Magnolia Members of the Platteville formation, will be conducted. The results will provide hydraulic data including (a) the degree of hydraulic separation between the Carimona and Magnolia members, (b) storage coefficients and transmissivity of the Magnolia and Carimona members, (c) vertical hydraulic gradients between Magnolia and Carimona members, and (d) the location of recharge and discharge boundaries, if any (General Mills 1989).

The aquifer tests require construction of two wells and are intended to provide ground-water level monitoring points that will produce the data necessary to design an effective extraction system.

Capture-zone design will be determined using an analytical ground-water model that is calibrated using data obtained from the aquifer tests. Modeling will be conducted using the analytic element flow-code SLAEM (Strach, 1989), and the model will be calibrated

to the observed steady-state piezometric surface of the Magnolia Member. Model results are intended to provide (a) the effectiveness of Well 108 in containing Magnolia groundwater, (b) the optimum locations for Magnolia wells, (c) the number of wells required for a Magnolia pump-out system, (d) optimum pumping rates for the wells, (e) and the effects of pumping in the Magnolia member on the vertical hydraulic gradients between the Magnolia and Carimona members (General Mills 1989).

EVALUATION OF SYSTEM PERFORMANCE

Shallow Aquifer

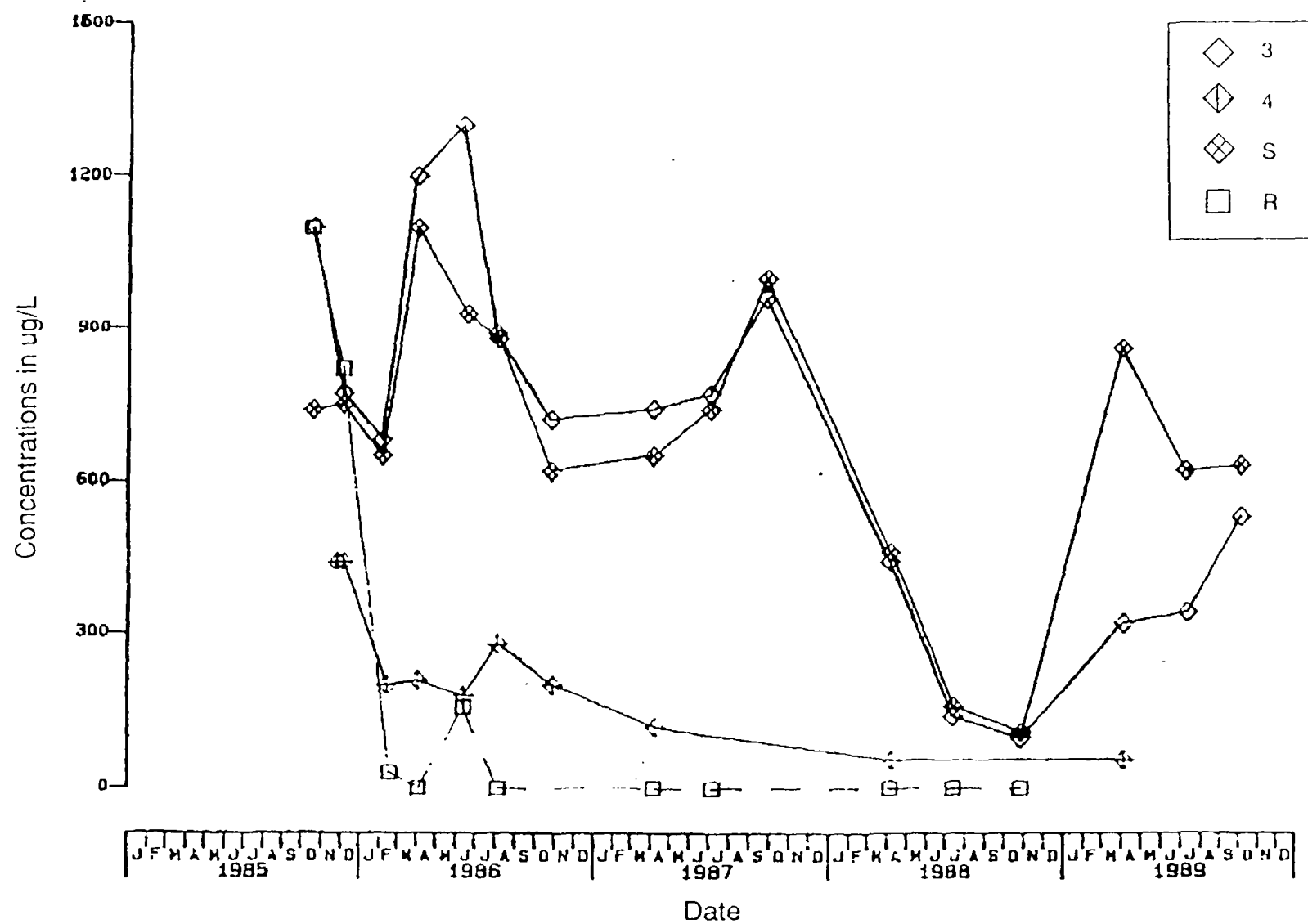
Total VOC concentrations increased during 1989 in three of the five monitoring wells in the shallow aquifer. TCE contaminant goals were exceeded in Monitoring Well S. Table 2 compares the total VOC/TCE concentrations for monitoring periods in 1984, 1988, and 1989. These data show that total VOC concentrations almost doubled in two monitoring well locations, increased slightly in a third, decreased in one well, and remained constant in another. Despite these levels, system operators contend that TCE contamination exceeding 270 ppb is being contained. Concentration data for the shallow aquifer are also shown in Figures 5, 6, and 7.

Carimona Member

TCE and total VOC concentrations in the Carimona Member are also displayed in Tables 2 and 3. Data from the initial case study show that the TCE levels greater than 27 ppb established a plume of concentration extending at least 250 feet from source area in the north and probably more than 1,000 feet to the south, east, and west. Data from 1989 reveal that TCE concentrations increased during 1989 both at the source and at monitoring locations.

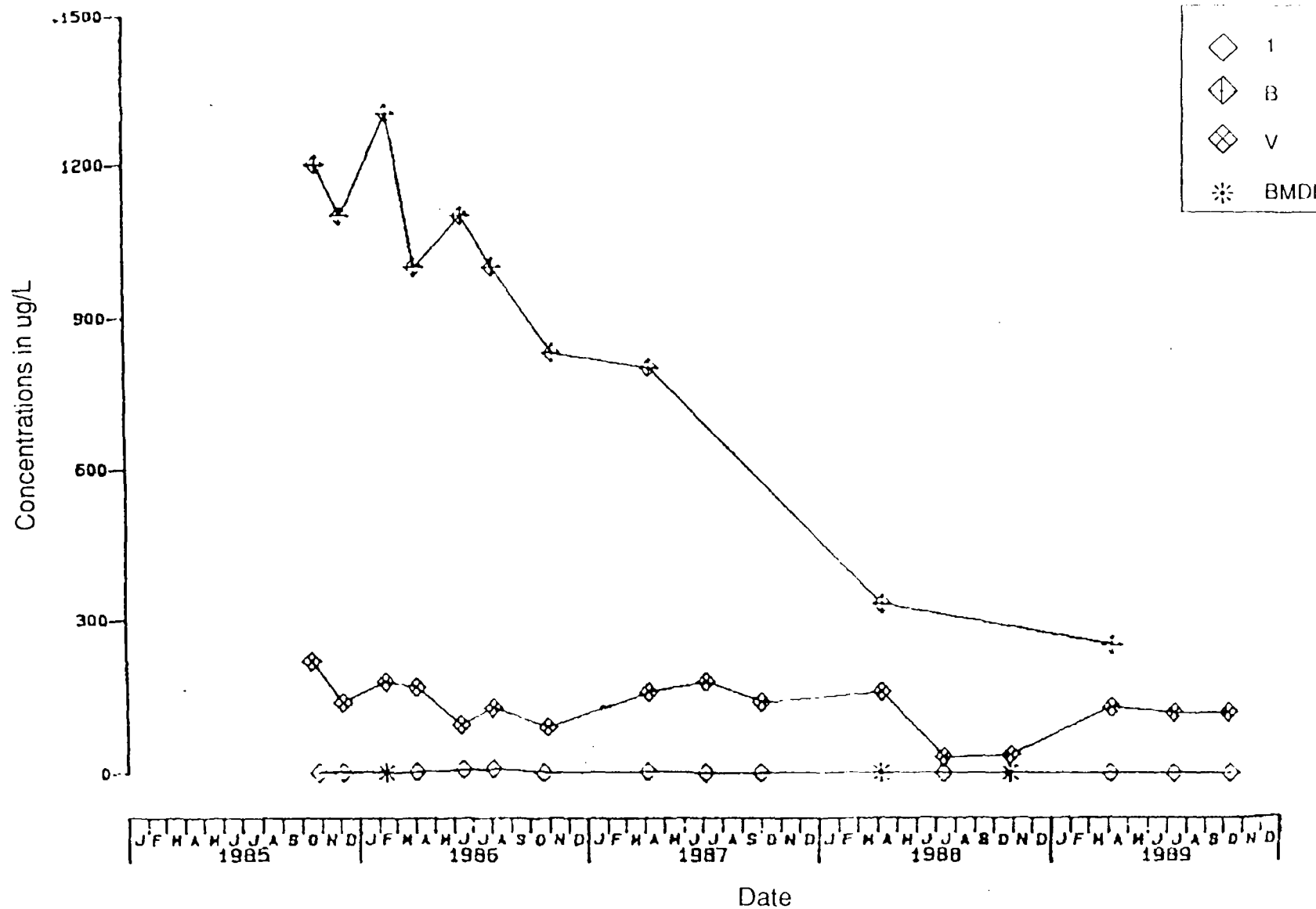
Table 2 TOTAL VOC AND TCE CONCENTRATIONS (PPB) SHALLOW AQUIFER AND CARIMONA MEMBER WELLS/1989			
Shallow Aquifer*			
Well	3-84 VOC/TCE	4-88 VOC/TCE	4-89 VOC/TCE
Q	56	6.2/0.86	13/1.1
S	850	520/460	910/860
T	BDL	BDL/<.50	BDL/<.50
V	100	180/160	140/130
W	11	67/43	86/57
Carimona**			
Well	4-89 VOC/TCE	7-89 VOC/TCE	12-89 VOC/TCE
108	570/530	340/340	540/490
BDL=Below Detection Limits *=TCE contaminant goal reduction level= <270 ppb **=TCE contaminant goal reduction level= <27 ppb Source: General Mills, 1989 Annual Report, 1990; EPA 1989.			

Table 3 TOTAL VOC AND TCE CONCENTRATIONS (PPB) CARIMONA MEMBER INFLUENT AND EFFLUENT/1989					
Influent					
Well	1-89 VOC/TCE	4-89 VOC/TCE	7-89 VOC/TCE	10-89 VOC/TCE	1-90 VOC/TCE
108	390/390	480/440	380/380	150/140	380/380
Effluent					
Well	1-89 VOC/TCE	4-89 VOC/TCE	7-89 VOC/TCE	10-89 VOC/TCE	1-90 VOC/TCE
108	9.8/9.8	18/13	20/20	200/190	96/96
TCE contaminant goal reduction level = <27 ppb Source: General Mills, 1989 Annual Report, 1990; EPA 1989.					



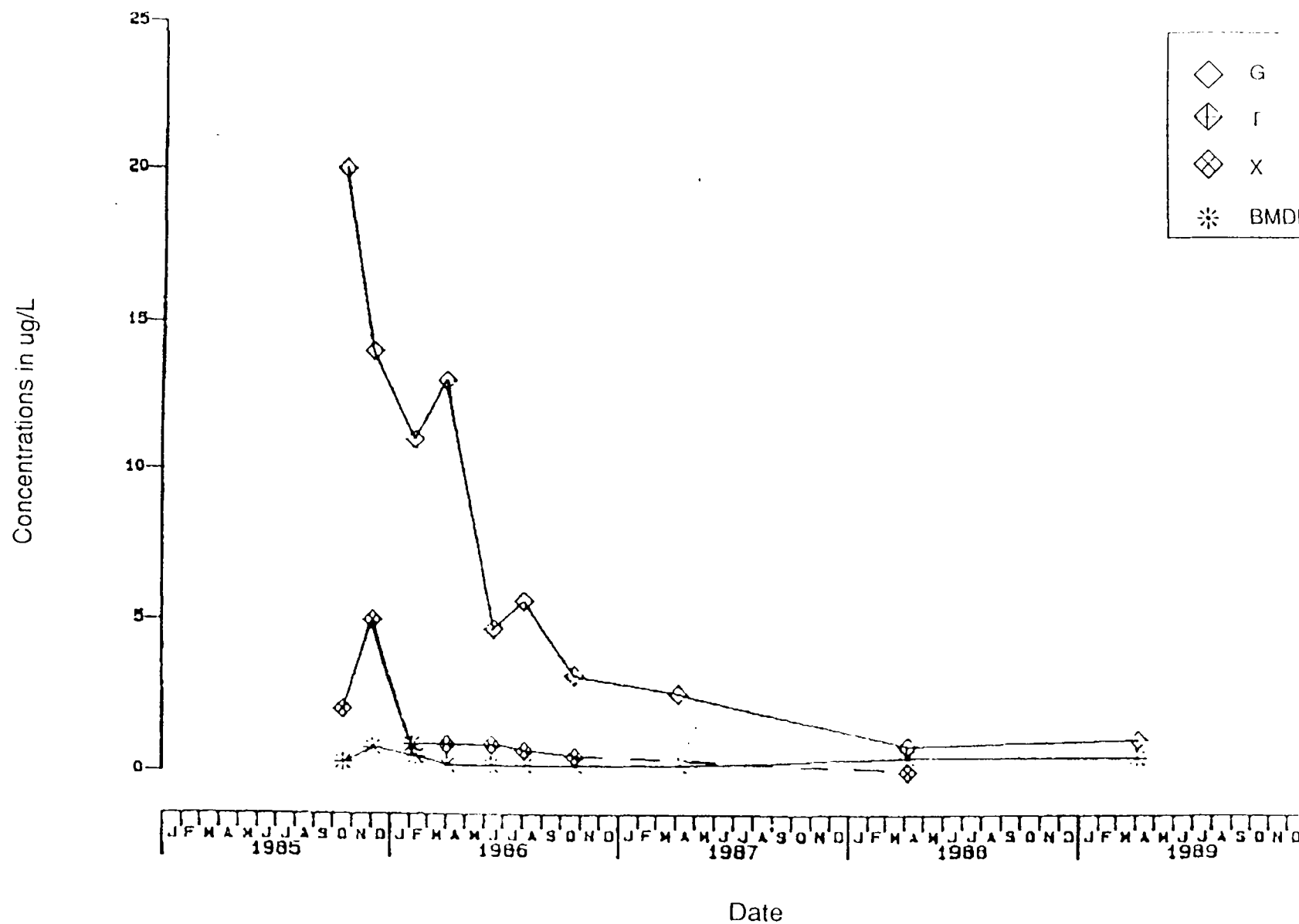
Source: BARR 1989

Figure 5
HISTORY OF TCE CONCENTRATION VARIATIONS IN
SHALLOW AQUIFER WELLS 3,4,5 AND R
GENERAL MILLS SITE, MINNEAPOLIS, MN



Source: BARR 1989

Figure 6
HISTORY OF TCE CONCENTRATION VARIATIONS
IN SHALLOW AQUIFER WELLS I, B, AND V.
GENERAL MILLS SITE, MINNEAPOLIS, MN



Source: BARR 1989

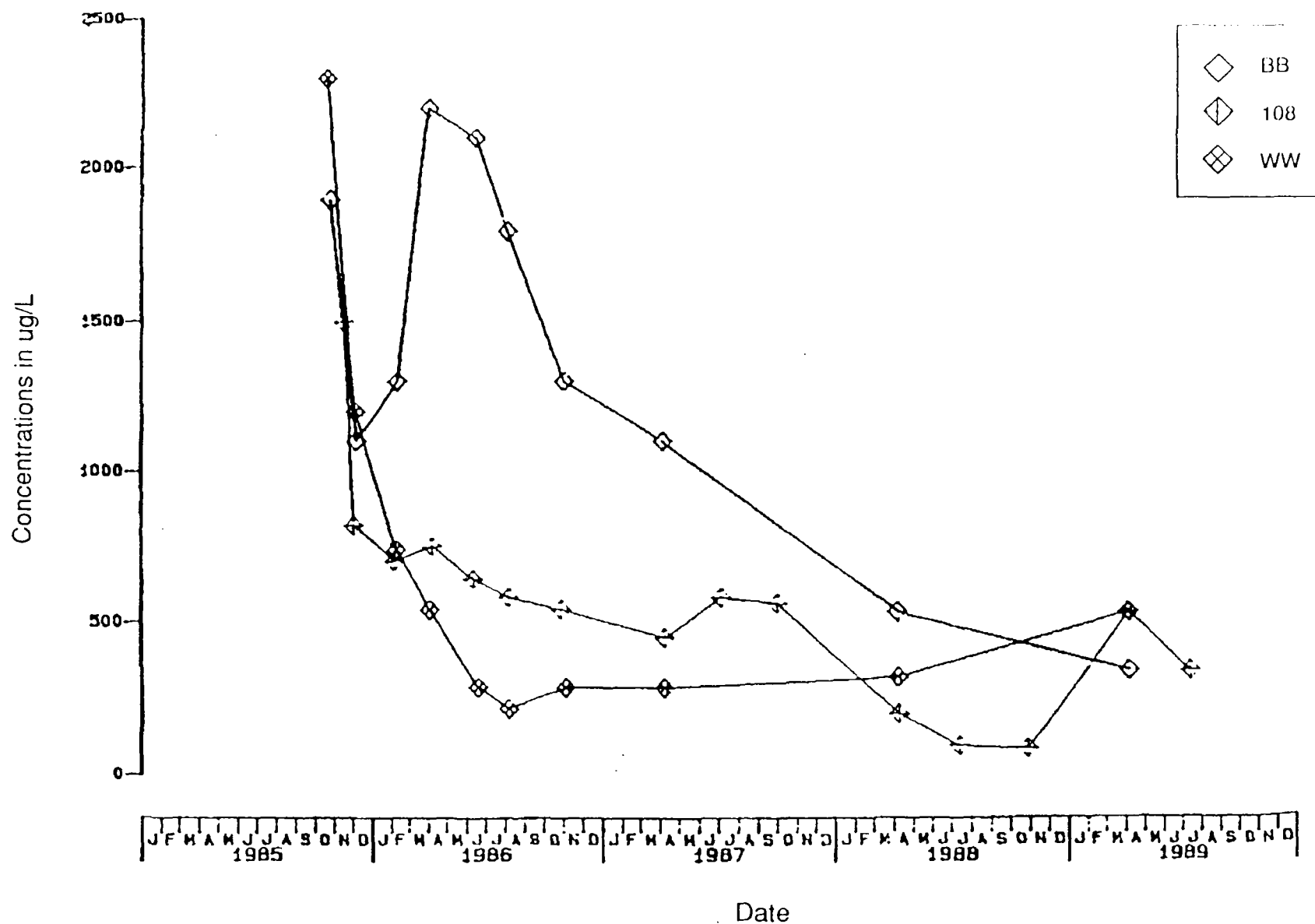
Figure 7
HISTORY OF TCE CONCENTRATION VARIATIONS
IN SHALLOW AQUIFER WELL G, T, AND X.
GENERAL MILLS SITE, MINNEAPOLIS, MN

According to the 1989 Annual Report for the site, effectiveness of extraction in the Carimona Member is reflected by a 70 to 90 percent reduction in TCE concentrations in most of Carimona monitoring wells. Time-series plots presented in Figures 8 and 9, however, show that while TCE concentrations continued to decline in monitoring Well BB, contaminant levels increased both in Wells 108 and WW. In Well 108, TCE concentrations for 1989 remained consistently above the target goal of less than 27 ppb. TCE concentrations for Wells 10, 11, and 13 on the southeastern periphery of the plume also increased. In 1988, TCE levels in Well 13 were below the detection limit, but increased to 110 ppb in 1989. System operators contend that, despite these increased concentrations, the contaminant plume is being contained.

The figures in Table 3 reveal that elevated TCE levels were also detected in 1989 and early 1990 in the treated effluent from the Carimona Member. In the first three quarters of 1989, the effluent released after treatment by air stripping was consistently below 27 ppb, with a 96 percent average treatment efficiency for total VOCs. Due to electrical and mechanical failures in the Well 108 pump, system operators recorded 46 days of downtime in the last three months of 1989. The total VOC levels rose to 200 ppb in the fourth quarter and the TCE levels increased from 20 ppb in the third quarter to 190 ppb in the fourth. Additional sampling in January 1990 revealed 96 ppb TCE, which is still above the NPDES maximum allowable average of 50 ppb and only slightly below the daily 100 ppb allowable daily concentration.

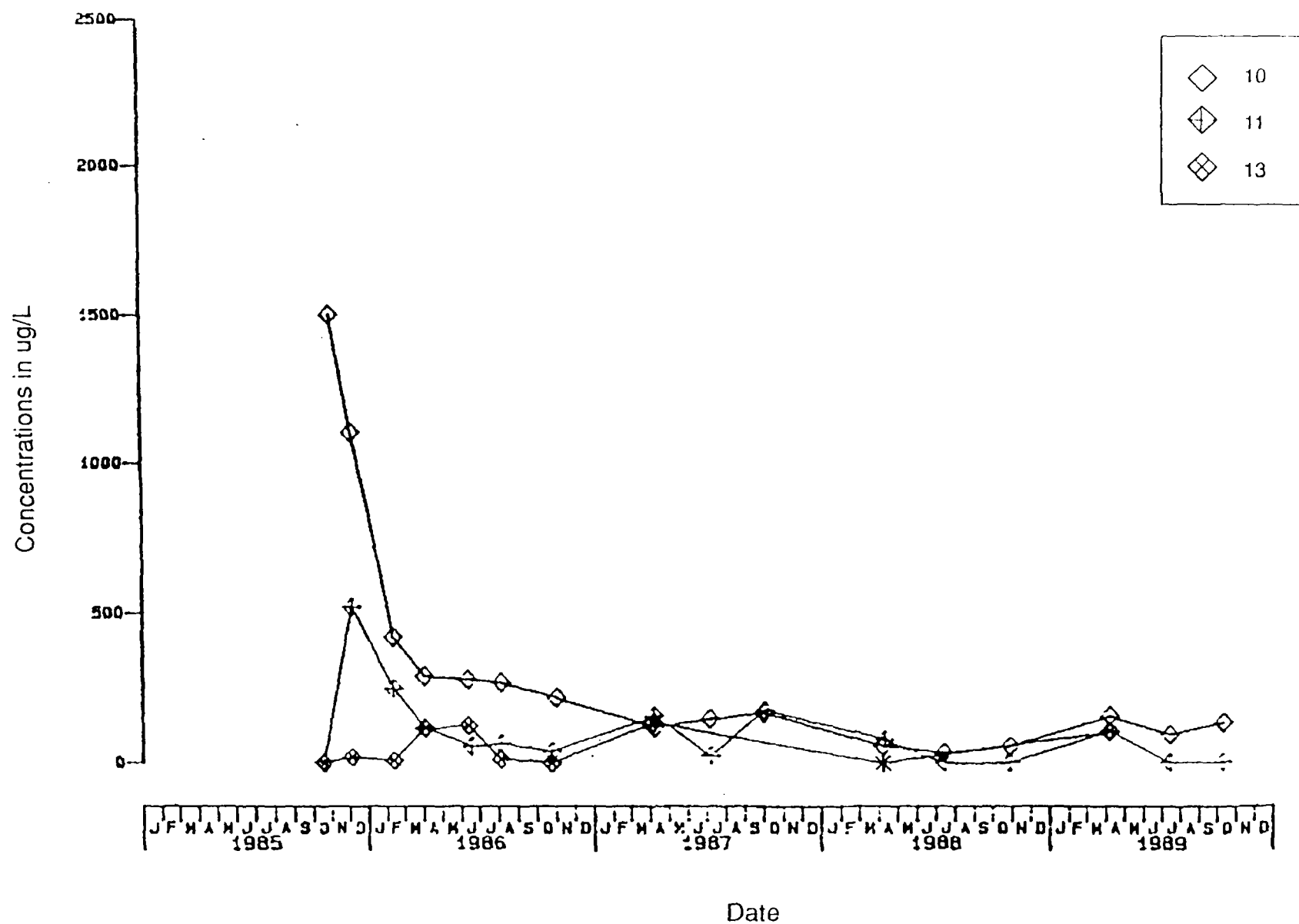
Influent and effluent data are also displayed as a time-series plot in Figure 10. This figure shows that, although 1989 levels of TCE were higher than those of 1988, contaminant concentrations continue to remain below the highest recorded levels documented in 1985 and 1986.

The Carimona extraction system was shut down in January 1990 due to the elevated VOC concentrations. Inspection of the air stripper revealed calcium carbonate on the interior surfaces of the tower (Barr 1989, Annual Report). The stripper tower was cleaned and the system resumed operations in early 1990.



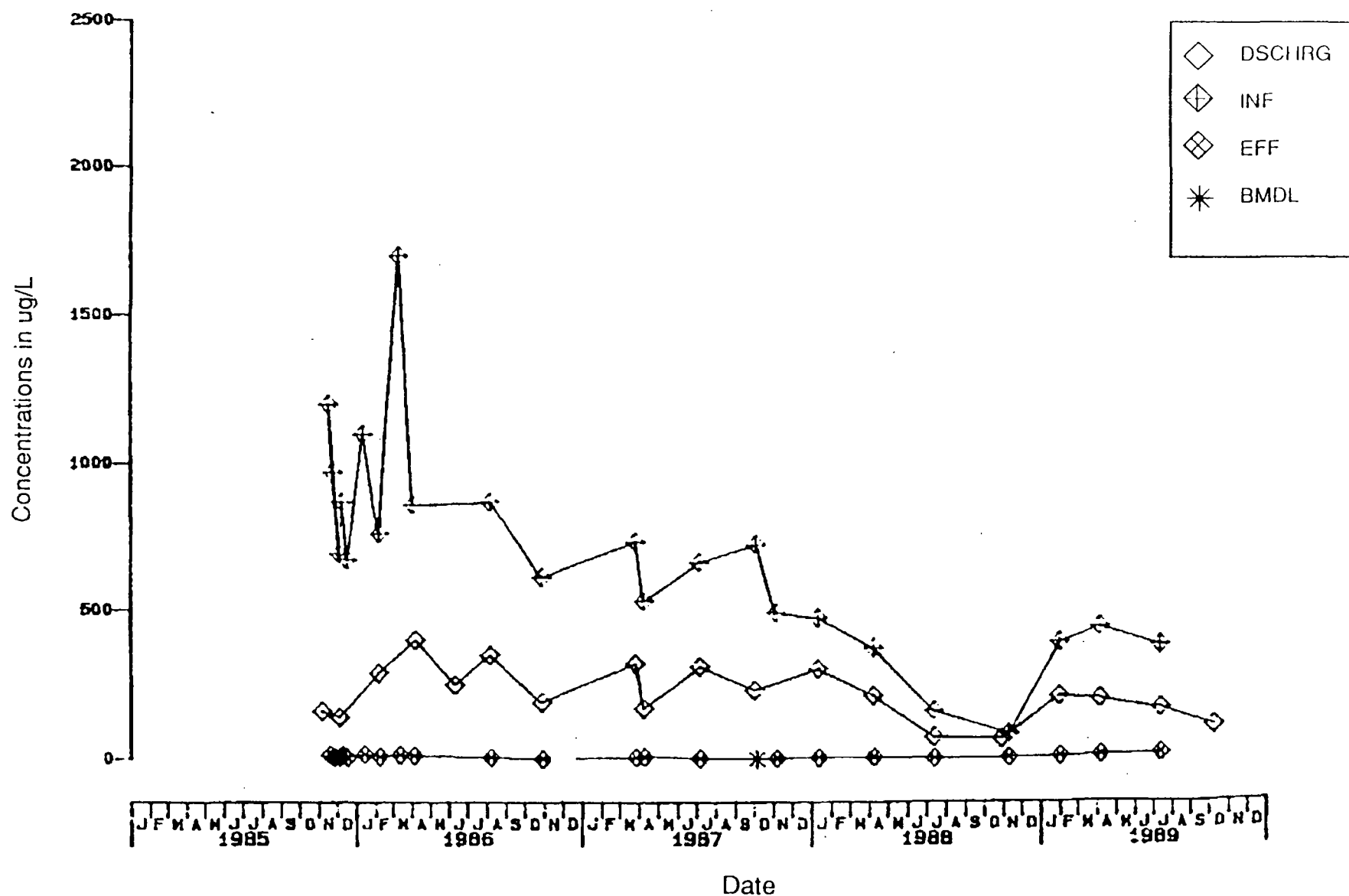
Source: BARR 1989

Figure 8
 HISTORY OF TCE CONCENTRATION
 VARIATIONS
 SCARIMONA MEMBER
 WELLS BB, 108, AND WW.
 GENERAL MILLS SITE, MINNEAPOLIS, MN



Source: BARR 1989

Figure 9
 HISTORY OF TCE CONCENTRATION
 VARIATIONS IN CARIMONA MEMBER
 WELLS 10, 11, AND 13.
 GENERAL MILLS SITE, MINNEAPOLIS, MN



Source: BARR 1989

Figure 10
HISTORY OF TCE CONCENTRATION
VARIATIONS IN CARIMONA MEMBER
WELL 108: INFLUENT, AND EFFLUENT
GENERAL MILLS SITE, MINNEAPOLIS, MN

According to the 1989 Annual Report for the General Mills site, water-level data obtained for the Carimona Member cannot be used to assess the true capture zone of this system because of the low observed hydraulic gradients at the site and the absence of monitoring points away from the site.

Magnolia Member

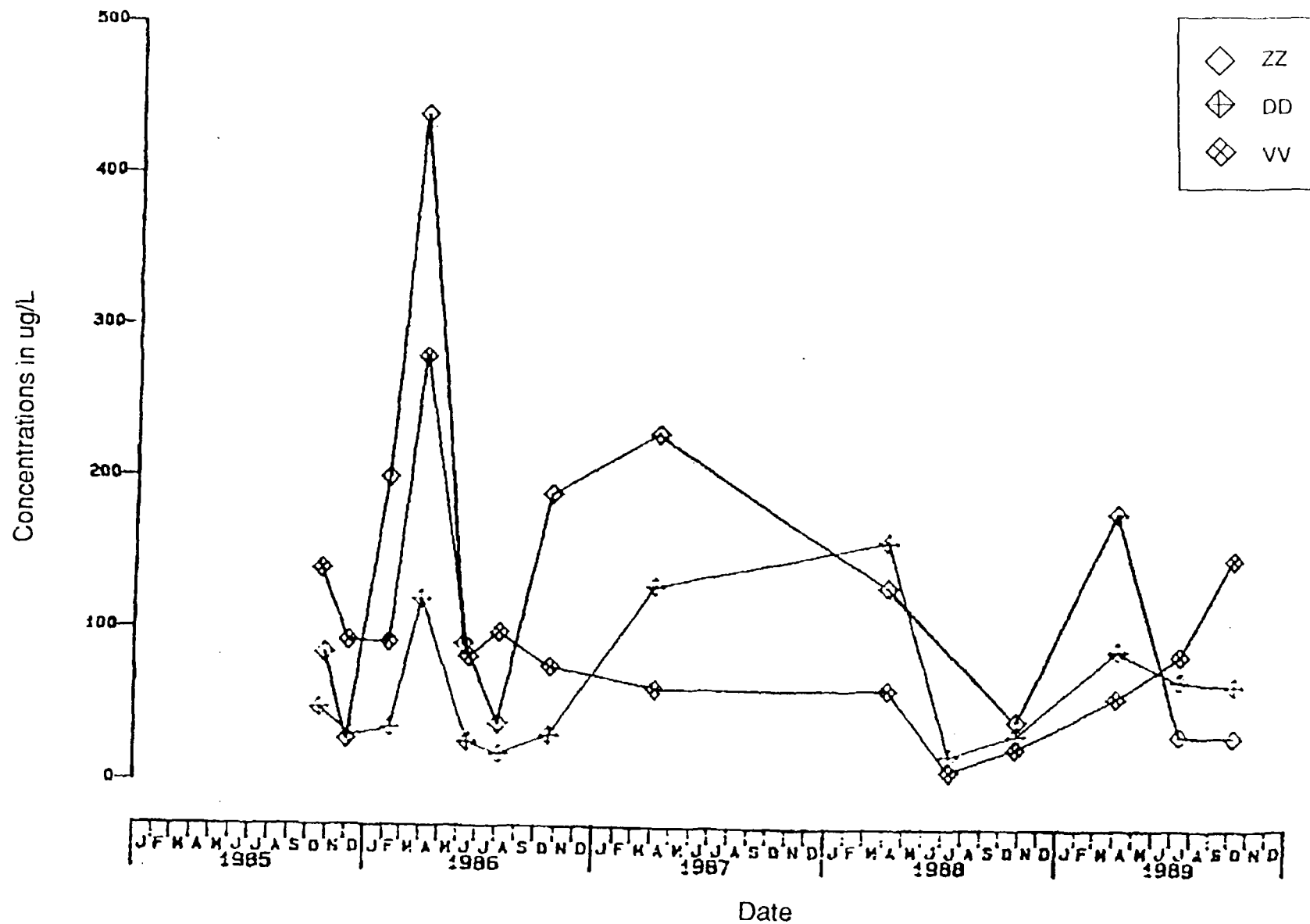
TCE concentrations in the Magnolia Member fluctuated during the 1985 to 1989 period. Figure 11 displays TCE contaminant levels ranging from more than 400 ppb to below the 27 ppb standard. Although TCE concentrations are still above the contaminant-reduction level, they appear to have stabilized well below the levels first detected in 1985 and 1986. Sampling results from April, July, and October 1989 revealed an average TCE concentration of 73 ppb.

The capture zone in the Magnolia has yet to be determined, and will be estimated using the results of the aquifer tests conducted in both the Magnolia and Carimona aquifers and the calibrated ground-water model that is based on the aquifer test results.

SUMMARY OF REMEDIATION

Changes in the General Mills extraction systems in 1989 include temporarily reduced extraction rates due to maintenance problems, increased contaminant concentrations, and planned construction of an additional extraction system.

During 1989, average extraction rates in the shallow-aquifer extraction system decreased due to pump malfunctions. Water levels in the shallow-aquifer source area wells are consistent with those identified in 1988, which suggests no progress in defining a distinct capture zone for the on-site wells. Elevations in the downgradient wells, however, have increased in the year interim since the original case study presentation, indicating limited capture of the contaminant plume. This possibility is supported by



Source: BARR 1989

Figure 11
 HISTORY OF TCE CONCENTRATION
 VARIATIONS IN THE MAGNOLIA WELLS
 ZZ, CO, AND VV.
 GENERAL MILLS SITE, MINNEAPOLIS, MN

increased TCE concentrations in monitoring Wells V and W downgradient of the extraction wells. The increases in water levels, however, may be partially attributed to increased rainfall and subsequent infiltration after the 1988 drought year.

Reduced pumping rates were also documented in the Carimona Member extraction system during 1989. The limited radius capture zone identified in 1985-86 was maintained until the fourth quarter of 1989 when electrical and mechanical failures occurred in the Carimona pumps, further reducing the limited capture-zone boundaries identified in the original case study. Limited capture is further indicated by substantial increases in TCE concentrations in peripheral monitoring locations.

The major change in the remediation program was the detection of above-threshold TCE levels and subsequent plans to construct an additional system in the Magnolia Member. These occurrences triggered renewed consideration of soil removal around the former disposal pit and an assessment of the source of the Magnolia contamination. To date, the source of contamination in the Magnolia remains unknown. MNPCA staff are unsure how this will effect the remediation goals of restricting further contaminant migration and improving ground-water quality.

Residual contamination in the form of NAPLs and an adsorptive layer of peat beneath the disposal pit is still suspected by MNPCA staff. Due to the fact that the water contained in the aquifers is not used for a water supply and contaminant-removal costs are prohibitive, additional detection efforts and remedial actions are not planned for either type of suspected contamination.

Because of the continued suspicion of residual contamination, capture zones not distinctly defined or maintained, and continued contaminant migration from an unidentified source, it appears unlikely that cleanup goals will be achieved in the foreseeable future in any of the contaminated aquifers.

SUMMARY OF NAPL-RELATED ISSUES

The staff of the MNPCA suspect that DNAPLs are present at the General Mills site. This appears probable because of the nature and quantity of the waste materials, the reported means of disposal, and the persistence of the contaminant plume in spite of more than 5 years of remediation. However, direct observation of nonaqueous liquids in the subsurface has not been reported.

Chlorinated solvents, in quantities of up to 1,000 gallons per year, were poured into a small pit for approximately 15 years. If it were assumed that 10,000 gallons were disposed of in that period, the total mass of chlorinated solvents would be approximately 100,000 pounds. Figure 4 of the original case study (EPA, 1989) shows a map of the total dissolved volatile organics (VOC) plume in the shallow aquifer as it was estimated from field data collected in March 1984, before the start of remediation. Assuming a retardation coefficient of 5 (reasonable for a sandy glacial drift), a porosity of 0.25, and a saturated thickness of 20 feet, this plume would contain approximately 3,000 pounds of dissolved and adsorbed VOCs. A substantial portion of the remaining 97,000 pounds of solvents is probably present as a DNAPL.

Although no estimates of the mass of contaminants removed by the extraction wells have been presented in the data reports, a rough estimate based on reported pumping rates and concentrations would be 200 to 400 pounds per year. At this rate, the system would take more than 200 years to remove the total mass of contaminants thought to be present. It is not surprising, therefore, that ground-water monitoring at the site does not show substantial decreases in contaminant concentrations.

The primary waste constituent, TCE, has an aqueous solubility of 1,100 ppm. This is much higher than the highest ground-water concentrations reported at the site (2,300 ppb). However, it is very common at sites known to have DNAPLs to find that the

maximum ground-water concentrations are far less than the aqueous solubilities of the contaminants.

It should be noted that soil concentrations of up to 2,000 ppm were reported for TCE when the soils around the disposal pit on the General Mills site were sampled. Although, the sorption properties of these soils have not been measured, it is likely that any ground water in contact with them would have solute concentrations near the solubility limit.

WDCR363/071.51

DRAFT

BIBLIOGRAPHY

Barr Engineering Company, Minneapolis Minnesota. Correspondence from Peter J. Sabee to Kathy Kramer, Minnesota Pollution Control Agency, May 8 1989.

Barr Engineering Company, Minneapolis Minnesota. Correspondence from Ray W. Wuolo to Mark Schmitt, Minnesota Pollution Control Agency, Saint Paul Minnesota, August 18, 1989.

Environmental Protection Agency. *Evaluation of Ground-Water Extraction Remedies: Volume 2, Case Studies 1-19*. Document Number EPA/540/2-89/0546. 1989.

General Mills, Inc., *Magnolia Aquifer Testing Work Plan: 2010 East Hennepin Avenue Site*, 1989.

General Mills, Inc. *1989 Annual Report: General Mills East Hennepin Avenue Site*. Minneapolis, Minnesota. January 1990.

Minnesota Pollution Control Agency, Saint Paul Minnesota. Correspondence from Rodney E. Massey, Director, Ground Water and Solid Waste Division to William Taylor, General Mills, Inc. October 29, 1990.

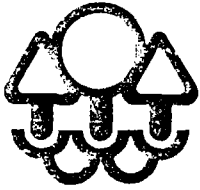
Minnesota Pollution Control Agency, Ground Water and Solid Waste Division, Saint Paul Minnesota, Internal Memorandum from Mark Schmitt, Re: Magnolia Aquifer Pump-And-Treat System, October 29, 1990.

Personal Communication. Frederick Campbell, Hydrologist, Superfund Unit, Site Response Section, November 16, 1990.

Personal Communication. Mark Schmitt, General Mills Site Project Manager, Minnesota Pollution Control Agency, Ground Water and Solid Waste Division, January 2, 1991.

Strach, O. D. L. 1989. *Groundwater Mechanics*. Prentice Hall, Englewood Cliffs, New Jersey.

WDCR363/071.51



Minnesota Pollution Control Agency

520 Lafayette Road, Saint Paul, Minnesota 55155-3898

Telephone (612) 296-6300



February 19, 1991

Ms. Christine L. Roberts
CH2M Hill
P.O. Box 4400
Reston, Virginia 22090

Dear Ms. Roberts:

Enclosed is a memorandum to me from Fred Campbell, Minnesota Pollution Control Agency Hydrologist for the General Mills Hennepin Avenue Site. The memorandum provides Mr. Campbell's comments on CH2M Hill's case study of the General Mills facility, which I now relay for your information and use.

If you have any questions, I can be reached at (612) 296-7776.

Sincerely,

Mark D.C. Schmitt, Ph.D.
Project Manager
Responsible Party Unit I
Site Response Section
Ground Water and Solid Waste Division

MDCS:pk

Enclosure

Office Memorandum

DATE : February 15, 1991

TO : Mark Schmitt, Project Manager
Site Response Section
Ground Water and Solid Waste DivisionFROM : Fred Campbell, Hydrologist *FKC*
Site Response Section *2-14-91*
Ground Water and Solid Waste Division

PHONE : 297-1799

SUBJECT : REVIEW OF DRAFT CASE STUDY UPDATE ON GENERAL MILLS SITE

I have read the draft version of the updated Case Study (Update) sent to us by CH2MHill. There are some portions of the update which require some comments. Overall the Update provides a good summary of the hydrogeology and ground water contamination related to the General Mills Site (Site). However, there are specific additions or changes that should be made to the Update. For example, on page 2, the first paragraph discusses the head differences between the Carimona and Magnolia Members of the Platteville Formation. Past reports from Barr suggest that there may be a net upward vertical gradient between the Magnolia and the overlying Carimona, at least in one part of the area (i.e. the vicinity of wells 22 and 13).

On page 8, the two tables require some additions and/or corrections. The March 1984 data for the Shallow Aquifer in Table 2 does not show the TCE concentrations for the five wells. Only the (total) VOC concentrations are given. These data are provided in the General Mills Annual Reports for 1989 and 1990. Table 3 is incorrect because it attributes the influent and effluent data from the Site Pump-Out and Treatment system to well 108 and the Carimona Member. The influent and effluent data are actually derived from composite water samples that represent wells 108, 109, and 110. Thus these data are not strictly Carimona water quality data since the two on-site glacial aquifer recovery wells contributed to the composite samples. Because of this fact, the TCE contaminant goal reduction level at the bottom of Table 3 is not applicable. The text on page 9 should also be changed to reflect the source of the referenced TCE levels.

The discussions regarding remediation and NAPL-related issues (pages 10-13) are interesting and very good. The authors appear to be leaning towards some other type of remediation for the Site (e.g. soil removal). The text makes numerous references to the questionable effectiveness of the pump-and-treat system, and there are some very valid points made in that regard.

FC:pk